

PRELIMINARY DRAFT. PLEASE DO NOT CITE.

Medicaid Managed Care in California and Health Care for Newborns

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Abstract

During the course of the 1990s, California significantly expanded the role of managed care in its Medicaid program. We exploit variations in the timing of implementation across counties to examine the impact managed care implementation had on spending and on health care use and outcomes for pregnant mothers and newborns. We find that the adoption of the program did not reduce spending, and may have increased it. Adoption of managed care is associated with noticeable changes in health care utilization, including changes in prenatal care use, hospital stays, use of “intensive” birth procedures like induction, and access to high-level NICUs for low birthweight newborns. Evidence on outcome impacts is mixed, with evidence suggesting better outcomes for some infants and worse for others.

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1. Introduction

Faced with rising expenditures for health care, and impressed by the apparent savings produced by managed care in the private sector, many state governments began moving their Medicaid populations into managed care during the late 1980s and 1990s. Between 1991 and 2001, the total number of people covered by Medicaid managed care, as opposed to traditional Medicaid fee-for-service arrangements, grew from 2.7 million to 22.0 million, accounting for more than 58% of all Medicaid beneficiaries in 2001.¹ Proponents of managed care claim that it is an efficient way to improve the quality of care and widen access to medical services.

Opponents, on the other hand, claim that cost-saving strategies of managed care like capitated reimbursements and utilization controls will compromise the health and well-being of managed care plan members.

We study the effects that adoption of Medicaid managed care in California had on health care and health outcomes for newborns between 1995 and 1999. Adoption of Medicaid managed care in California is largely the result of a change in state policy in the early 1990s that led to the implementation of managed care in a number of California counties, but at different times and to different extents across counties. We exploit the arguably exogenous policy change and variation in implementation timing to obtain our estimates of the effects of Medicaid managed care

We focus on health care and health outcomes for infants. An important emphasis of Medicaid policy over the past 2 decades has been improving care for pregnant mothers and newborns. Newborn health care is also a setting in which it is quite plausible that managed care

¹2001 figures from CMS, “Medicaid Managed Care State Enrollment, December 31, 2001,” accessed March 15, 2003 from www.cms.hhs.gov/medicaid/managedcare/mmcp01.pdf. 1991 figures from [Uninsured, 2001 #775].

has important effects. Managed care organizations frequently emphasize their commitment to prevention, and may therefore have differential effects on prenatal care use. Managed care organizations also frequently encourage less intensive care patterns than FFS, and there are a number of relatively intensive procedures like cesarean delivery and electronic fetal monitoring that can accompany birth. Care for very low birthweight infants may also be influenced since care for this group tends to be very expensive and may attract the attention of plans seeking to control costs (CIGNA 1992; Cutler and Meara 1997).

We use detailed microdata from hospital discharge records linked to birth and death certificates for all births in California for 1995-1999 to estimate the effects of managed care on a variety of measures of newborn health care use and outcomes. We find that, while managed care did not reduce spending, it did bring about a number of changes in care patterns. Our evidence on outcomes is mixed, but some evidence suggests better outcomes for very low birthweight newborns.

2. Previous Literature

“Managed care” is not clearly defined, but is generally taken to be a collection of activities that health plans can undertake to manage the use of medical services and control costs. These activities often consist of some combination of financial incentives to providers, direct management of utilization, and restrictions on patient choices of providers. Managed care plans also often engage in the collection and monitoring of utilization and quality information, the production and dissemination of guidelines, and other activities designed to improve the care delivered to their patient population and/or reduce costs.

A large body of research examines the effects of managed care on health care delivery and outcomes in various settings, for various populations, and for various health conditions.

Much of this literature is summarized in one or more of a number of previously published reviews, including those by Miller and Luft (1994, 1997), Dudley (1998), and Glied (2000). Among this literature are a number of studies of the effects of Medicaid managed care on health care use and outcomes among various populations (see e.g. Hurley, Freund, and Paul, 1993; Szilagyi, 1998; Carey and Weis, 1990; Carey, Weis, and Homer, 1990; Kaiser Commission, 1995 for overviews), and work on the effects of managed care on children (e.g. (Valdez, Ware et al. 1989; Freund and Lewit 1993; Aitken, Warden et al. 1997; Schwartz, Kellogg et al. 1998; Szilagyi 1998; Long and Coughlin 2001; Newachek, Hung et al. 2001).)

Within this broader literature, there are a number of studies that examine the effects of Medicaid managed care on health care for newborns. Much of this work consists of cross-sectional comparisons, either of Medicaid recipients who are and are not enrolled in managed plans or of Medicaid recipients in areas where Medicaid managed care plans have and have not been adopted. By and large, this literature reports no strong differences between Medicaid managed care and FFS. Carey, Weis, and Homer (1991) compared prenatal care use and neonatal outcomes in Santa Barbara county California, and Jackson county, Missouri, which had early Medicaid managed care demonstration programs, to nearby non-managed care counties. They reported no differences in prenatal care use, birthweight, pregnancy complications, and cesarean section rates between Medicaid managed care and traditional Medicaid. Oleske *et al.* compared Santa Barbara and San Mateo counties in California to similar nearby counties, finding some evidence of improved birthweights in managed care but no differences in adequacy of prenatal care, cesarean rates, or the likelihood of adverse pregnancy outcomes (Oleske, Branca et al. 1998). Tai-Seale *et al.* (2001) also examined Santa Barbara and San Mateo counties, compared to another non-managed care California county and found evidence for reduced length of stay, better primary care and cost savings with managed care (Tai-Seale,

LoSasso et al. 2001).

Oleske *et al.* (2000) examined all births in California and Florida in 1993, comparing those covered by Medicaid managed care to those covered by traditional Medicaid and reporting that the overall likelihood of an adverse maternal outcome during hospitalization for a delivery was not significantly different between Medicaid managed care and Medicaid FFS groups (Oleske, Linn et al. 2000). A similar study found no strong differences between cesarean delivery or vaginal birth after cesarean section (VBAC) rates between managed care and non-managed care Medicaid patients (Oleske, Linn et al. 1998).

Work by Goldfarb *et al.* (1991) compared 1988 deliveries at the Hospital of the University of Pennsylvania among women from a region of west Philadelphia that was part of Philadelphia's Medicaid case management program to deliveries in the same hospital among FFS Medicaid women from another Philadelphia region that was not part of the program. No differences between the two groups were found in cigarette, alcohol, or drug use during pregnancy, the course and extent of prenatal care, birth weight, gestational age, or mortality.

Krieger, Connell, and LoGerfo (1992) compared cohorts of mothers who chose to join Medicaid managed care plans to others in FFS Medicaid. They found no differences in prenatal care use between the two groups. They also found no statistically significant difference in birthweight between the two groups, although there was a hint that the birthweight distribution might be somewhat better among the managed care group.

Another group of studies compares populations in the same areas before and after implementation of Medicaid managed care plans. Ray *et al.* (1998) examined birth outcomes before and after the implementation of TennCare, the Medicaid managed care plan in Tennessee. They found no changes after TennCare implementation in prenatal care use, birthweights, or 60 day mortality rates. Cooper *et al.* (1999) report that implementation of TennCare improved

continuity of coverage for infants and children. A study of the implementation of Chicago's Healthy Moms/Healthy Kids program found better prenatal care after managed care was implemented (Raube and Merrell 2000). A study of the implementation of Medicaid managed care in Rhode Island also found improvements in prenatal care (Griffin, Hogan et al. 1999).

Perhaps the strongest evidence on the effects of Medicaid managed care comes from a study by Levinson and Ullman (1998), who examined 1994 births in three counties in Wisconsin, including 2 counties where some Medicaid recipients were randomly enrolled in Medicaid managed care and some remained in FFS Medicaid. Despite the random assignment, they still found some evidence of biased selection in the managed care plan. But after taking extensive steps to control for it, they found better prenatal care use among the managed care patients, but no differences in birthweights.

As a whole, this literature fails to find consistent strong evidence of either better or worse care in Medicaid managed care plans, although there are regular hints of possibly better care for Medicaid recipients in managed care plans, including better prenatal care use and sometimes better birthweights. But existing results are limited in some important ways. Much of the work is cross-sectional in nature, and thus heavily dependent on the assumption that the areas compared or the populations compared are identical (conditional on the control variables) with respect to unobserved health system, population, and other area characteristics. But these assumptions are easily violated. Notably, evidence suggests that there is often biased selection into managed care plans (Hellinger 1987; Hellinger 1995; Glied 2000) and even a randomized trial of Medicaid managed care encountered difficulties from selection through biased disenrollment from the managed care plans (Leibowitz, Buchanan et al. 1992). Before and after comparisons of an area adoption Medicaid managed care depend on the assumption that that there were not other temporal changes in health care delivery that confound the results.

Several of the studies rely on samples that are too small to detect the infrequent differences in quantifiable delivery-related outcomes like mortality. Most studies consider the results of a small number of managed care plans. Nearly all of them rely on limited data sets that exclude numerous variables that may be correlated with birth outcomes, such as detailed maternal and infant characteristics or hospital characteristics. Most of the studies report on the experience of a few places that adopted pilot programs in the late 1980s and early 1990s, which may not reflect the effects of widespread adoption seen in the later 1990s.

By studying the California experience, we can control for both differences across counties and over time, exploiting the natural experiment that arises from different adoption times in different counties, and alleviating many of the difficulties of selection bias. Our data also allow us to examine a wider variety of utilization and outcome measures than have been considered previously, study a large population, and control for an extensive set of potentially important confounding variables.

3. The Implementation of Medicaid Managed Care in California

3.1. Overview

California's Medicaid program is called Medi-Cal. Historically, the vast majority of Medi-Cal recipients were covered under the traditional Medi-Cal program, in which recipients could choose any physician or hospital they desired (and were able to obtain an appointment with), and Medi-Cal reimbursed providers on a fee-for-service basis. In addition to the traditional program, Medi-Cal has offered managed care plans to some of its recipients for a number of years. As far back as the early 1970s, recipients in some California counties were

offered the opportunity to join a managed care plan if they wished to do so.²

Most early Medi-Cal managed care efforts were relatively weak and did not enroll large numbers of recipients. The two exceptions are efforts in 1983 by Santa Barbara county and 1987 by San Mateo county to organize managed care plans for their Medi-Cal recipients and require essentially all recipients enroll in them.³ These marked the beginning of the move toward so-called mandatory managed care, but opportunities for further expansion were limited by the regulatory climate. Strong further shifts toward mandatory managed care in California did not occur until passage of state enabling legislation and the receipt of a series of HCFA waivers in the early 1990s paved the way for the Department of Health Services to begin implementing mandatory managed care in a number of California counties beginning in 1994. Under mandatory managed care, all Medi-Cal recipients in “mandatory aid categories” in the county are required to join a managed care plan.⁴ (We discuss the mandatory aid categories further below.) By 1999, the end of the time period covered in our empirical analyses below, mandatory managed care had been implemented in 22 counties (including San Mateo and Santa Barbara, which adopted in the 1980s) and covered more than 2.5 million beneficiaries, about half of the total Medi-Cal enrollment (Klein 2000). Other beneficiaries continue to receive traditional fee-for-service Medi-Cal coverage.

²More detail on the history and specific operations of Medi-Cal managed care plans can be found in Department of Health Services (1993) and in the State of California’s Managed Care Annual Statistical Reports, particularly the 1998 issue (Klein, 1998).

³Monterey county also adopted a mandatory managed care plan in 1983, but discontinued it in 1985.

⁴There were parts of Kern, Los Angeles, San Bernardino, and Riverside counties that were exempted from mandatory managed care because they were too rural or otherwise had a population too low to support a managed care plan. Recipients in the associated “carve out zip codes” were not required to join.

The decision to implement mandatory managed care reflected the general opinion that managed care would be able to produce savings for Medi-Cal while maintaining or improving quality of care. There is no indication that the overall decision to move toward mandatory managed care was related to any specific expected changes in health care utilization or outcomes. The counties in which mandatory managed care was implemented, though, were not chosen at random. The state sought to develop mandatory managed care in areas where there were large numbers of beneficiaries, the support of local officials, and the necessary managed care infrastructure to support it (see Department of Health Services, 1993). This resulted in adoption in the most highly populated, urban counties in California – 21 of the 22 counties with the highest populations adopted Medicaid managed care. None of the 23 counties with populations under 100,000 adopted Medicaid managed care. Table 1 lists counties in California with 1998 populations over 100,000, and indicates those where mandatory managed care was implemented. This has implications for our identification strategy. One approach in studies like this is to compare adopting counties with non-adopting counties, but in this case these two groups are sufficiently different that we cannot adopt this strategy.

Instead, we identify effects of Medicaid managed care by focusing on the group of counties that did adopt, exploiting the fact that Mandatory managed care was implemented at different times in different counties. Santa Barbara and San Mateo counties implemented during the 1980s. Mandatory managed care was implemented in 20 of the 21 remaining adopting counties between 1994 and 1999. Figure 1 shows the adoption timeline. Among these counties, variations in implementation timing resulted from a number of factors. Various state administrative issues prevented all of the implementations from going forward simultaneously. Further, many aspects of implementation depended on county personnel, and counties varied in their degree of preparedness to handle the process.

There is no evidence that variation in implementation times was intentionally associated with population health or expected health care use or outcomes. In simple comparisons of birth rates, infant mortality, and percent of births under 2500g, counties adopting in or before 1996, adopting in 1997, and adopting in 1998 or 1999 all showed similar trends leading up to the mid-1990s implementation period (Figure 2). (There are differences in levels between the groups, which we can account for with county dummies in our analysis.)

3.2. Managed Care Models

There are 4 different models of mandatory managed care that have been implemented in different counties.⁵ Eight counties use the “county organized health system” (COHS) model, in which there is a single county-operated managed care plan that accepts Medi-Cal recipients. These plans are overseen by county boards that receive capitation payments from the state and accept financial risk. The boards operate or contract with networks of providers to deliver care. Although these plans typically operate only within the designated county, they are quite similar to commercial HMOs. They have restricted networks of providers from which enrollees are required to choose, can employ utilization review and other techniques to manage utilization, and have strong incentives to control costs. Perhaps the most important difference between COHS plans and commercial HMOs is that the boards are required to contract with any willing traditional “safety net” providers in the county, restricting the bargaining power of the plan with respect to these providers to some extent.

The “two-plan” model was intended by the Department of Health Services to be the main

⁵There continue to be other versions of Medi-Cal managed care that are non-mandatory and/or apply to specific populations, including Prepaid Health Plan, Primary Care Case Management, and Special Products plans. These plans enroll fewer than 45,000 Medi-Cal beneficiaries. The PHP and PCCM plans are being phased out in favor of mandatory managed care.

mandatory managed care model, and has been implemented in 12 counties. In a county with a two-plan model, there is both a commercial managed care health plan and a county-developed “local initiative” health plan similar to the plans in COHS counties available to serve Medi-Cal recipients.⁶ Both plans receive capitated payments from the state for Medi-Cal enrollees, accepting risk.⁷ In most two-plan counties, the majority of the enrollment ends up in the local initiative.

The “geographic managed care” (GMC) model is used in Sacramento and San Diego counties. In these counties, there is no county-operated plan; all of the plans are commercial managed care plans that contract directly with the state. Although the specifics vary, plans in GMC counties are typically paid by the state on a fully capitated basis. Sacramento had 6 plans operating in 2000 and San Diego had 7.

The final model is the “fee-for-service-managed care” (FFS/MC) model, in place in 2 counties, in which the state continues to pay for care on a fee-for-service basis, but all beneficiaries are assigned to a primary care provider for medical case management. The primary care providers are charged with coordinating care and managing the use of medical services.

Under the first 3 models, the specific activities of the various plans accepting Medi-Cal beneficiaries can vary, as is the case across health plans in general.⁸ Nonetheless, all of the plans

⁶In Fresno county, the county was unable to implement a local initiative plan, so the two plan model there operates with two commercial plans.

⁷Although the contracting terms are generally the same for the local initiative and commercial plans in two plan counties, the capitation payments can vary. Typically, the local initiatives are paid higher capitation rates than the commercial plans to compensate for their disproportionate share of sick individuals.

⁸For example, local initiatives and COHS’s are more likely to use per diem hospital payments, while the commercial plans are more likely to use capitation for hospital services only. Commercial plans also appear to be less likely to capitate individual primary care providers and develop public health promotions [Hunt, 1999 #760].

are faced with similar capitation-driven financial incentives, and operate in general like managed care plans.

Various factors influenced decisions about which model of managed care would be adopted in a given county. Early mandatory Medi-Cal managed care counties used the COHS model because this was the only legally allowable option before the early 1990s. More recent implementations of COHS model plans are limited by a federal restrictions on the number of COHS plans that can operate, and on the share of enrollment that can be in COHS plans. The state's intent in the mid-1990s expansion was to focus on the development of the two plan model and hence it was enacted in most locations. The GMC and FFS/MC models were implemented as demonstration programs, and were placed in areas where county personnel and managed care plans were amenable.

In our analysis, we examine COHS, two-plan, and GMC counties. We treat all plans equally, although clearly future work distinguishing the effects of different models would be useful.

3.3. The Meaning of Mandatory

Mandatory managed care is only mandatory for some groups of Medi-Cal recipients. In COHS counties, essentially all Medi-Cal recipients are required to enroll in the managed care plan, with small exceptions for groups whose membership in other plans precludes joining an HMO (e.g. qualifying Medicare beneficiaries) or very recently established eligibility groups for which data needed to set capitation rates are not yet available. In GMC and two-plan counties, Medi-Cal managed care is mandatory only for a subset of the Medi-Cal population. Here, the three main categories of recipients required to join a managed care plan are those in the 1931(b) (formerly AFDC-linked) group, the Medically Needy with no share of cost group, and the

Medically Indigent Children group. Those eligible under the percent of poverty rules, including many of those brought into the Medi-Cal program with the expansions in the 1980s, are not required to join. In two-plan and GMC counties, recipients in non-mandatory eligibility groups can join the managed care plans if they wish, but state analysts report that less than 5% of the managed care enrollment in these counties is voluntary (Klein 2000).

3.4. Effects of mandatory managed care adoption

Over the period we study, 1995-1999, there are steady increases in the share of Medi-Cal-covered women age 15-44 who are in Medi-Cal managed care (Figure 3). These general increases reflect marked changes county-by-county that occur when Medi-Cal managed care is adopted in a given county. Figure 4 shows the trend for Alameda county, which adopted its two-plan model beginning in January of 1996 and completed implementation in July of 1996. The pattern for Alameda county has 3 characteristics typical of enrollment changes related to the adoption of a two-plan model. First, in Alameda as in many counties, there was some managed care enrollment prior to the adoption of Mandatory managed care. This reflects enrollment in previous non-mandatory managed care programs in operation. Second, enrollment increases slightly once implementation begins, but jumps more distinctly when implementation is complete. Two-plan counties were only allowed to force beneficiaries into the managed care plans once implementation was complete. Finally, post adoption enrollment levels are in the 60% - 70% range. In two-plan counties, not all aid categories are required to enroll in managed care plans.

Figure 5 shows the trend for Orange county, which adopted its COHS plan in October of 1995. Here adoption took place at a single point, and enrollment increased dramatically with adoption. Managed care coverage rates reach about 80% in COHS counties because most aid

categories are required to enroll.⁹ Figure 6 shows the trend for Sacramento county, which adopted its GMC plan in July of 1998. In the two GMC counties, enrollment drifts upward after implementation, but there is less of a clear jump because of difficulties in implementation. With similar mandatory aid categories as two-plan counties, enrollment in GMC counties tops out at 60-70% after implementation.

These figures track the share of women age 15-44 in Medi-Cal managed care. It is difficult to compute the number of births covered by Medi-Cal managed care plans before and after the implementation of mandatory managed care, but estimates produced by state analysts suggest that the fraction of births covered by managed care plans is consistent with overall patterns of enrollment in managed care plans (Rains 2001).

3.5. Welfare Reform and Medi-Cal Enrollment

In January 1998, California implemented CalWORKS, the California version of the TANF program adopted as part of the 1996 welfare reform legislation. The shift to the time-limited, work-oriented program resulted in significant reductions in the number of people covered by CalWORKS over time. In January 1996 there were 2.6 million people enrolled in AFDC in California. By January 1999, approximately the end of the time period we study here, the number enrolled in CalWORKS had declined to 1.8 million. The number of people in CALWorks declined further to 1.5 million by June 2000.

⁹There are several reasons that managed care enrollment is less than 100% even in fully implemented COHS counties, including 1) beneficiaries that receive Medi-Cal retroactively are treated as FFS beneficiaries for the retroactive period; 2) beneficiaries with other coverage (e.g. CHAMPUS, Medicare, CCS in some counties) are excluded from enrolling in a managed care plan; 3) there is often a lag between becoming eligible and selecting a managed care plan, during which recipients are covered by FFS Medi-Cal; and 4) the Department of Health Services grants medical exemptions to a small number of beneficiaries.

Since Medi-Cal has historically been linked to the cash assistance programs, these declines raise questions about changes in the number of total Medi-Cal recipients and potential changes in the composition of the Medi-Cal covered population. At one level, these issues do not appear strongly concerning since the state made efforts to maintain access to Medi-Cal for those whose status with respect to the AFDC/TANF programs changed, including the establishment of new Medi-Cal eligibility categories specifically for those who were transitioning off of the former AFDC program. Overall declines in the number of people covered by Medi-Cal are relatively small. There were 5.4 million Medi-Cal enrollees in January 1996. By January 1999, the number had fallen somewhat to 5.0 million, and it rose slightly to 5.1 million by June 2000 (Maloy and Happoldt 2001).

These figures are comforting, although they do not completely dispel the potential for concern at more subtle levels. California did experience some challenges in maintaining access to Medi-Cal for individuals making transitions in the welfare programs, and at the same time was bringing in new Medi-Cal enrollees from other population groups, notably those made eligible under the Medicaid expansions and targeted by outreach and enrollment efforts. This raises the possibility that there are changes in the composition of the Medi-Cal population over time even if total enrollment did not decline significantly. Our data on the number of Women age 15-44 covered by Medi-Cal do show an 11% decline between 1996 and 1999, from 769,000 to 685,000, slightly larger than the decline in the total number of enrollees. We cannot rule out the possibility that there were changes in composition, but would note that changes in the Medi-Cal population over time that are constant across counties will be absorbed in our differences-in-differences approach. Second, we can include a number of controls for the characteristics of mothers and infants in our models below, which should absorb key aspects of any potential difference.

4. Empirical Approach

This paper studies the impact of managed care by exploiting the implementation of mandatory managed care over the 1995-1999 period. During this period, an arguably exogenous shift in state policy led to the implementation of mandatory managed care plans, which were adopted at different times in different counties for arguably exogenous reasons. Even though some of these so-called mandatory plans did not cover all Medi-Cal recipients, in every case they produced an noticeable increase in enrollment as many Medi-Cal recipients were required to join managed care plans. We study changes in health care use and outcomes for Medi-Cal covered mothers and children as Medi-Cal managed care is being implemented.

4.1. Models

Our primary analyses are conducted using a differences-in-differences approach to identify the effects of managed care, exploiting differences in timing of adoption. We take the counties in which managed care was implemented,¹⁰ and estimate a model of the following form:

$$Y_{ijt} = \beta_0 + \beta_1 * C_j + \beta_2 * T_t + \beta_3 * MC_{ijt} + \beta_4 * X_{i,j,t} + \epsilon_{ijt} \quad (1)$$

where i indexes individuals, j indexes county, and t indexes time. Y is a measure of health care use or outcomes, C is a vector of county dummies, T is a vector of monthly time dummies, MC is the share of Medi-Cal covered women age 15-44 in a Medi-Cal managed care plan in county j in month t , and X is a vector of additional controls that can include individual, area, or hospital characteristics. ϵ is an error term.

¹⁰We includes San Mateo and Santa Barbara counties, which had mandatory managed care since the 1980s, even though our data only run from 1995-1999. Excluding these two counties does not noticeably influence the results. We exclude Placer and Sonoma counties, which use the FFS/MC model because this program is substantially different from the other managed care models.

We use OLS to estimate equation (1) for all of our models, even those with dichotomous dependent variables, to facilitate the use of fixed effects and interpretation. Results from logistic models are consistent where we have experimented with them. In equation (1), β_3 captures the differences-in-differences estimate of the change in utilization or outcomes associated with the implementation of mandatory managed care. That is, it is the change in the mean of the utilization or outcome variable from before to after implementation of managed care, net of changes over time common to all of the counties and of the average level within each county over time. The implicit assumption is that the counties adopting managed care are mutually an appropriate set of comparison counties with which to absorb any secular trends in the utilization or outcome variables we study.

4.2. Data

Our data are drawn from a dataset of linked birth certificates, OSHPD maternal and infant hospital discharge records, and death certificates for all California births occurring between January 1, 1995 and December 31, 1999.¹¹ We extract births covered by Medicaid. There is more than one potential way to identify births covered by Medi-Cal in this data, including the expected source of payment on the mother's discharge abstract, expected source of payment on the newborn's discharge extract, and the mother's self reported expected source of payment for labor and delivery on the birth certificate. We elected to use the mother's discharge abstract expected source of payment since this seems likely to be a more important determinant of prenatal care use, hospital of delivery, and receipt of care during labor and delivery than the

¹¹We exclude newborns with birthweights under 500g to avoid difficulties arising from variation in the coding of fetal deaths. We exclude births that occurred outside of hospitals or in military hospitals.

newborn's expected source of payment. Moreover, in Medi-Cal, newborns are automatically covered by the Mother's insurance until other determinations are made or unless the family has other coverage for the newborn. In our data, 98% of the cases where the mother's discharge record indicates Medi-Cal, also show Medi-Cal as the baby's expected source of payment. We expect the hospital coding of expected source of payment to be more accurate than the mothers self-report on the birth certificate.¹²

We focus on births that occurred in the 21 counties in which mandatory managed care was implemented under the two plan, COHS, or GMC models during the time period we study.¹³

¹⁴ This excludes Placer and Sonoma counties, which adopted managed care under the FFS/MC model since the incentives under this model are potentially different than the incentives under the others. This set of 21 counties consists of relatively homogenous, mainly large and urban, counties in California. In the end, our data set for analysis contains 979,839 Medi-Cal covered births in counties that adopted mandatory managed care.

¹²One way to get information about the validity of the discharge data coding of expected source of payment is to compare the expected source of payment on the discharge data to data on expected source of payment for labor and delivery reported by mothers on the birth certificates. Although the mother's self reported may contain measurement error, at least in principle errors from the two sources have a chance of being orthogonal. The overall correspondence between the two measures is quite good. In the entire dataset, 95.0% of the cases where the mother's expected source of payment on the discharge record is "Medicaid" also have "Medicaid" as the expected source of payment for labor and delivery on the birth certificate. 92.6% of the cases with "Medicaid" on the birth certificate have "Medicaid" on the discharge abstract.

¹³This excludes Yolo county, which adopted Medi-Cal managed care in 2001.

¹⁴San Bernardino, Riverside, Los Angeles, and Kern counties are all mandatory managed care counties, but there are a number of zip codes in these counties that are excluded from the mandate. We treat residents of these zip codes as if they were residents of a county that did not adopt mandatory managed care. In implementing this, we use the list of exempted zip codes in effect as of 2000, which we are told includes some zip codes that were originally exempted but have since been included in the mandatory managed care areas. For this unknown but likely very small number of areas, we will put the date of mandatory managed care implementation too early.

There is a decline in Medi-Cal covered births over time, from 208,000 in 1996 to 175,000 in 1998 (16%). Some of this is likely due to declines in the number of women of child-bearing age covered by Medi-Cal, but the decline in births is slightly larger than the decline in the number of women 15-44 in Medi-Cal. This could reflect a decline in birth rates for this population. Another possibility is that this is the result of some miscoding in the hospital expected source of payment category, where it seems possible that some Medi-Cal managed care discharges could be coded private HMO instead of Medi-Cal. (There is an increase in the number of births coded private HMO over this period, which, although it could be due to many things, it also consistent with this theory.) Even if there is some shifting from Medi-Cal to the private HMO or other private groups, it is not clear whether this is systematic with respect to health status or the result of random coding errors.

For each newborn, we link data on the share of women age 15-44 covered by in Medi-Cal managed care from DHS MEDS files in the county of birth and month of birth.

5. Medi-Cal expenditures

Before we turn to our analysis of health care use and outcomes, we briefly examine the extent to which Medi-Cal managed care has produced reductions in expenditures for the state. This is an important aspect of an overall assessment of the effects of Medi-Cal managed care and helps set the stage for our subsequent analyses.

We use state government figures for county-by-county spending. Since 1994, the California Department of Health Services has published a report indicating total expenditures for FFS Medi-Cal by county of beneficiary residence, total capitation payments for managed care

plans by county,¹⁵ and enrollment. We used these data to calculate total spending and spending per eligible, by county and year. Statewide, total Medi-Cal spending rose from \$11.0 billion in 1994 to \$13.4 billion in 1999, and continued up to \$16.9 billion in 2001. Expenditures per enrollee rise from \$2,029 in 1994 to \$2,673 in 1999, to \$2,949 in 2001.

Figure 7 shows average spending per beneficiary in counties that did and did not adopt mandatory managed care. This comparison is imperfect since those counties that adopted are more highly populated and more urban than those that did not, but the fact that the trends in spending for the two groups are similar over time does not suggest large impacts of Medicaid managed care adoption on spending patterns.

To obtain point estimates of the changes in spending associated with the implementation of Medi-Cal managed care, we estimated a set of regressions of county-year expenditure measures on a dummy variable indicating whether the county had implemented mandatory managed care, a set of county dummies, and year dummies. We use data on only counties that adopted Medi-Cal managed care. Results are shown in Table 2. Columns 1 and 2 show results from models that use total spending and spending per beneficiary. Columns 3 and 4 replicate columns 1 and 2 using log expenditures. The results suggest that the implementation of managed care was associated with increases in total expenditures and expenditures per eligible.

This runs counter the general expectation the implementation of managed care would produce savings for the state, and is consistent with work by Duggan that used more detailed

¹⁵The capitation data do not include excess risk liability payments, adjustments for enrollees with AIDS, or retroactive capitation rate adjustments made after April of the following year (e.g. 2000 for 1999 data), and any Medicare recovery, and therefore understate actual spending somewhat. These adjustments are not expected to be large. For FY 1995-1996, for example, excess risk liability adjustments totaled about \$5.8million, and adjustments for enrollees with AIDS totaled about \$2.5m [Belshe, 1997 #799]. The figures include a small amount of capitation payments to the small number of non-mandatory managed care plans in existence during this time period.

data (Duggan 2002).

6. Results for health care utilization and outcomes

6.1. Prenatal Care

Many managed care plans emphasize their commitment to preventive care, of which prenatal care is a central example. Although prenatal care may not have strong impacts on outcomes for most births, for mothers at with significant risk behaviors or treatable medical conditions, effective prenatal care can markedly improve birth outcomes. The financial incentives of capitation would seem to create a strong incentive for managed care plans to expend considerable effort promoting prenatal care for their enrollees.

The birth certificate data include the mother's self-reported time at which prenatal care began and the number of visits. From this data, we constructed an indicator for the number of prenatal care visits meeting or exceeding the adequate number as defined by the Kotelchuck index (Kotelchuck 1994; Kotelchuck 1994), and an indicator for whether or not prenatal care began in the third trimester which would be an indication of poor prenatal care. On average across all years, 69% of the Medi-Cal covered births had adequate prenatal care, consistent with other studies of prenatal care adequacy in this population (Kogan, Martin et al. 1998; Griffin, Hogan et al. 1999). 4.5% of births were to mothers who had not started prenatal care until the 3rd trimester.

Columns 1 and 2 of Table 3 report regression results from models where the dependent variable is the number of prenatal visit. Column 1 shows results from models that include county and year dummies, but no controls for other characteristics. There is a reduction in the number of visits associated with managed care implementation, although the result is of only marginal statistical significance. This result persists when controls for basic demographics are

added to the model (column 2). Columns 3 and 4 indicate that the probability of starting prenatal care in the 3rd trimester increases with mandatory managed care, and columns 5 and 6 show declines in the share deemed to receive adequate prenatal care according to the Kotelchuck index.

6.2. Birthweight

Birthweight is frequently thought to be an important determinant of birth outcome (or at least an important statistical predictor), although it can be difficult for medical care to influence in all but marginal ways. Birthweight is also a frequently used measure in previous work on Medicaid managed care.

The birth certificates report each newborn's birthweight in grams. We examined trends in birthweights measured continuously as well as in the fraction of births under 2500 grams, termed low birthweight (LBW) infants. Among Medi-Cal births in our sample, the overall average birthweight was 3,327 grams. 6.2% of newborns were of low birthweight. Regression results for birthweight are shown in Table 4. Although there are trends toward better birthweights, there are no statistically significant effects of the introduction of Medi-Cal managed care on birthweights.

6.3. Care Utilization

We now turn to analyses of a series of measures of the kinds of health care used and the intensity of treatment associated with birth (Table 5). The first measure is the mother's length of stay for the birth hospitalization. Among Medi-Cal recipients in our sample, the average length of stay is 1.99 days. Implementing mandatory managed care is associated with reductions in length of stay.

We identified births that took place in hospitals with public ownership. One potential impact of the Medi-Cal managed care program is the movement of mothers from public hospitals into private hospitals that are more commonly used by managed care plans. We find that increases in the share of women 15-44 in Medi-Cal managed care is associated with a significant decrease in the probability of giving birth in a public hospital.

Electronic fetal monitoring is another intensive treatment that often accompanies births. Fetal monitoring is a technology that can provide advance warning of impending complications in labor and delivery. However, some argue that rates of fetal monitoring are excessive, and that the use of fetal monitoring can frequently identify minor problems that, once identified, lead to further unnecessary intensive treatments. The birth certificates code the use of electronic fetal monitoring, including use during the pregnancy before labor and delivery and during labor and delivery itself. In our data, 60.7% of Medi-Cal deliveries received used electronic fetal monitoring, the majority during labor and delivery. The implementation of managed care is associated with a statistically significant decrease in the use of fetal monitoring.

Induction of labor is another intensive treatment that often accompanies birth. Some reports suggest that use of induction has been increasing in recent years among the non-Medicaid population. We find that Medi-Cal managed care is significantly associated with more use of induction.

Cesarean delivery is an important intensive service that many suggest should be used less often. Moreover, cesarean deliveries are expensive. In Medi-Cal, payments for cesarean deliveries are about 67% higher than payments for normal deliveries (\$4,091 vs \$2,447 in 1999) (Rains 2001). Finally, rates of cesarean delivery and vaginal birth after cesarean (VBAC) delivery are frequently viewed as a way of assessing quality of care (Schimmel, Schimmel et al. 1997; Oleske, Linn et al. 1998), including being a part of the HEDIS measures. The birth

certificates code the method of delivery for each birth. We used these data to identify the use of primary cesarean and normal delivery,¹⁶ as well as whether the mother had a prior cesarean delivery. We then model the use of cesarean delivery among women with no history of cesarean delivery (“primary cesarean”), and the use of normal delivery among women with a history of cesarean delivery (“vaginal birth after cesarean section” or VBAC). Regression results show no impact on Cesarean delivery rates, but a noticeable increase in VBACs associated with managed care implementation.

One overall inference is that Medi-Cal managed care has moved the Medi-Cal population in directions similar to those experienced by non-Medi-Cal births in recent years: shorter lengths of stay, more inductions and VBAC, but less fetal monitoring.

6.6. Access to NICUs.

For very low birthweight infants, access to neonatal intensive care services can dramatically improve their prognosis (Williams and Chen 1982; Phibbs, Bronstein et al. 1996), but at significant cost (CIGNA 1992; Cutler and Meara 1997). Hospitals vary in the level of neonatal intensive care units (NICUs) they have available. Level III facilities (also called regional or tertiary facilities) are the most technologically advanced and have the equipment and specialized staff to care for the most seriously ill newborns. Level II units (also called community NICUs) can care for moderately sick infants but generally do not provide assisted ventilation for more than 4 hours. In California, as in some other places, there are now a number of Level II+ NICUs, which provide long-term ventilation, but not all the services and expertise offered by a tertiary NICU.

¹⁶We include in normal delivery cases of vaginal birth with forceps or vacuum assistance.

We linked data on the level of NICU facilities available at the hospital of birth to the birth data. We model the probability that 500-1499g newborns and, separately, 1500-2499g newborns are born in level II+ and III centers. These infants are at high risk for adverse health events including death, benefit substantially from advanced NICU care, and by guidelines ought to be treated in tertiary NICUs. In our sample, there are 10,335 500-1500g infants and 52,205 1500-2499g infants covered by Medi-Cal. Of these, many are born outside of hospitals with level III NICUs, and many are born in hospitals with no NICU at all or only a level II facility.

There is a marginally significant trend toward high probability of birth in a hospital with a level III NICU as the share in Medi-Cal managed care increases, but only a weak increase in the probability of being born in a level II+ or III hospital (Table 6). This can be interpreted as indicating that managed care plans are effective at moving high risk births into level III units specifically before birth occurs.

Transfers between hospitals can also play a role in providing adequate care for VLBW newborns delivered at hospitals without appropriate facilities, although outcomes for newborns transferred after birth are inferior to outcomes for those born in appropriate facilities to begin with (Gortmaker, Sobol et al. 1985; Phibbs, Bronstein et al. 1996). When we repeat the analysis using the highest level of care reached via transfers, here we find that while managed care is more likely to get newborns into the highest level of care hospitals before birth, they are less likely to transfer those that are born elsewhere, with a net result that increases in the managed care share are associated with lower rates of use of level II+ and III units overall, though this result is imprecisely estimated.

For 1500-2499g newborns, growth in managed care appears to increase the probability that a newborn will be born in a hospital with a level II+ unit, but not a level III unit. In the highest level models, managed care increases the probability of admission to a level III unit.

6.7. Outcomes

Mortality is an important outcomes for newborns, and for VLBW newborns in particular. We used linked death certificate data to construct an indicator for death within 28 days of birth, or before leaving the hospital, based on linked death records and hospital discharge abstracts. Using 28 day mortality instead of in-hospital mortality avoids introducing bias from the “shifting” of death from the first few days of life through the use of intensive care services. Piper (1991) finds some evidence of this practice during the late 1980’s in Tennessee. Restricting the period to 28 days rather than a longer time prevents the inclusion of deaths caused by postnatal problems that are less related to delivery and prenatal care, such as pneumonia or sudden-infant-death syndrome.

In the regressions, there is not a significant association between managed care enrollment rates and mortality rates, although the point estimates of the effect among 500-1500g newborns are consistently negative, suggesting possible improvements in mortality rates (Table 7). Note that in both cases, there is little effect of including controls for the NICU level in the birth hospital, suggesting that changes in access to NICU care is not associated with any movements in mortality rates.

We also examined two other outcome measures. While bronchopulmonary dysplasia, a condition of the lungs, occurs in many VLBW newborns for reasons unrelated to the care they receive, it is also possible for lower quality care to cause BPD. Movements in the mean BPD rates would thus be an indication of potential quality of care changes. Similarly, intraventricular hemorrhage (IVH) is a condition that occurs in many newborns despite good care, but which can also be the result of inadequate care.

For both BPD and IVH, we find significant reductions in rates associated with increases in Medi-Cal managed care share. These would tend to suggest better quality of care and better

outcomes, although since there is some noise in the measures we wish to be somewhat cautious in drawing conclusions. As in the case of mortality we find no effects of adding controls for the level of the NICU care available in the birth hospital, so it does not appear that shifting access to NICUs is associated with this decline.

8. Conclusions

We find evidence that the adoption of Medi-Cal managed care in California was associated with higher spending and also associated with a number of changes in treatments and perhaps in outcomes as well. A main goal of the state of California was to reduce spending by adopting Medi-Cal managed care. Our evidence suggests that this did not occur. At the same time, another goal was the provision of quality care for beneficiaries. Our evidence suggests that use of Medi-Cal managed care led to a number of changes in care for Medi-Cal managed care beneficiaries that are consistent with trends in care for non-Medicaid patients. Our evidence also suggests improvements in health outcomes for very low birthweight newborns.

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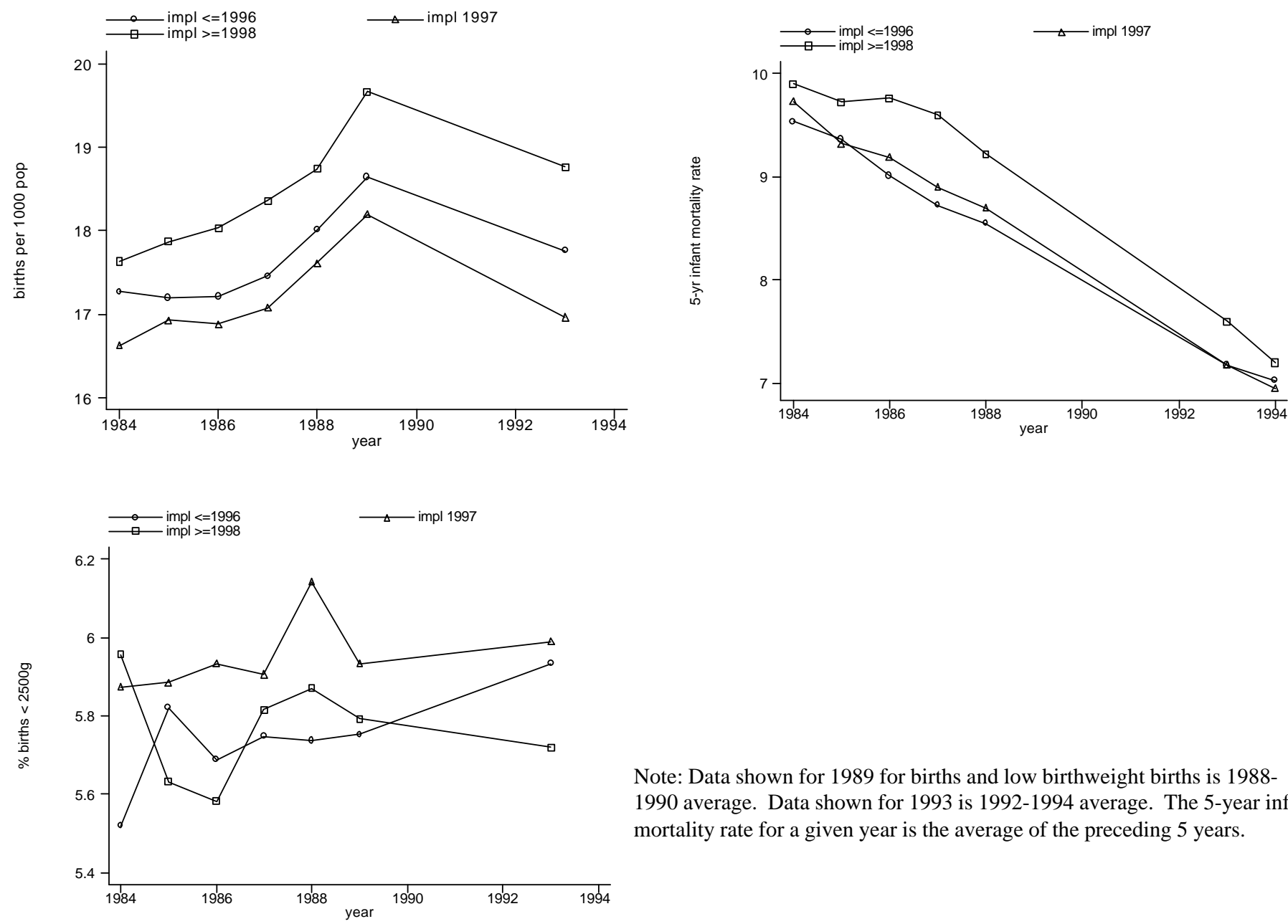
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Figure 1: The implementation of mandatory managed care in California

1983	1987	1994	1995	1996	1997	1998	1999	2001
Santa Barbara	San Mateo	Sacramento	Orange	Alameda	Contra Costa	Napa	Tulare	Yolo
Monterey (1983-1985)		Solano		Kern	Fresno	Riverside	Monterey	
				Santa Cruz	Los Angeles	San Bernardino		
					Placer	San Diego		
					San Francisco			
					San Joaquin			
					Santa Clara			
					Sonoma			
					Stanislaus			

Figure 2: Trends in births, infant mortality, and percent low birthweight in early, middle, and late implementing counties



Note: Data shown for 1989 for births and low birthweight births is 1988-1990 average. Data shown for 1993 is 1992-1994 average. The 5-year infant mortality rate for a given year is the average of the preceding 5 years.

Figure 3: Share of All Medi-Cal Enrolled Women Age 15-44 Covered by Medi-Cal managed care

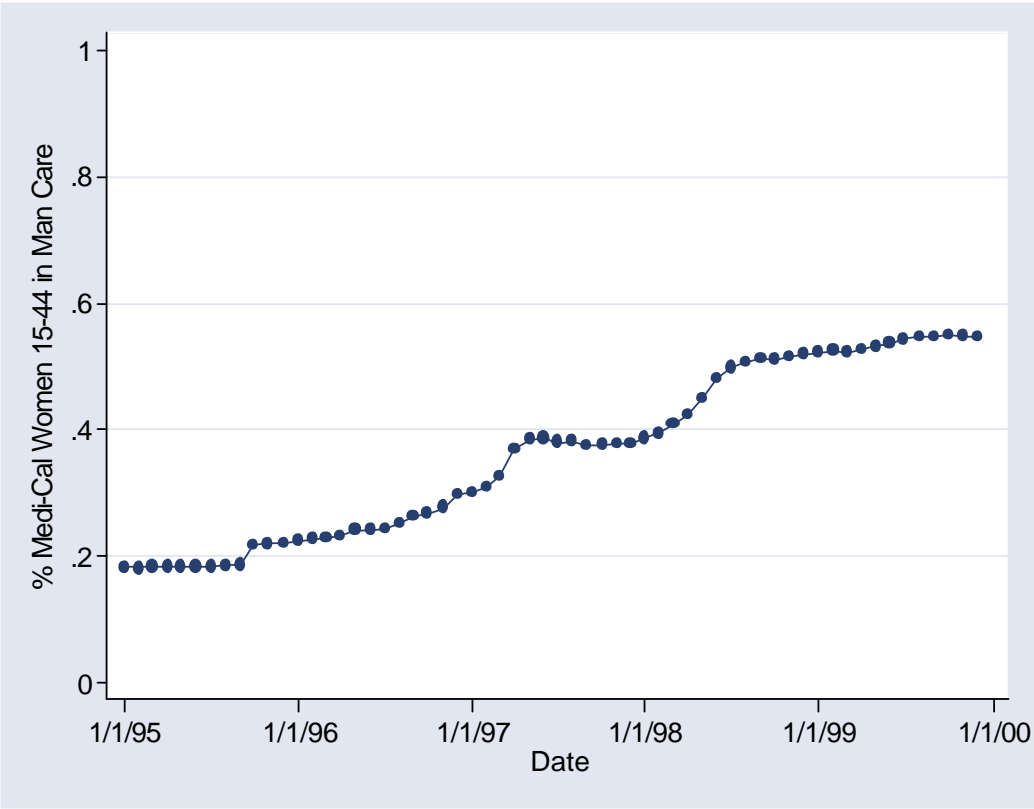


Figure 4: Share of Medi-Cal Covered Women 15-44 in Medi-Cal Managed Care, Alameda County (2-plan)

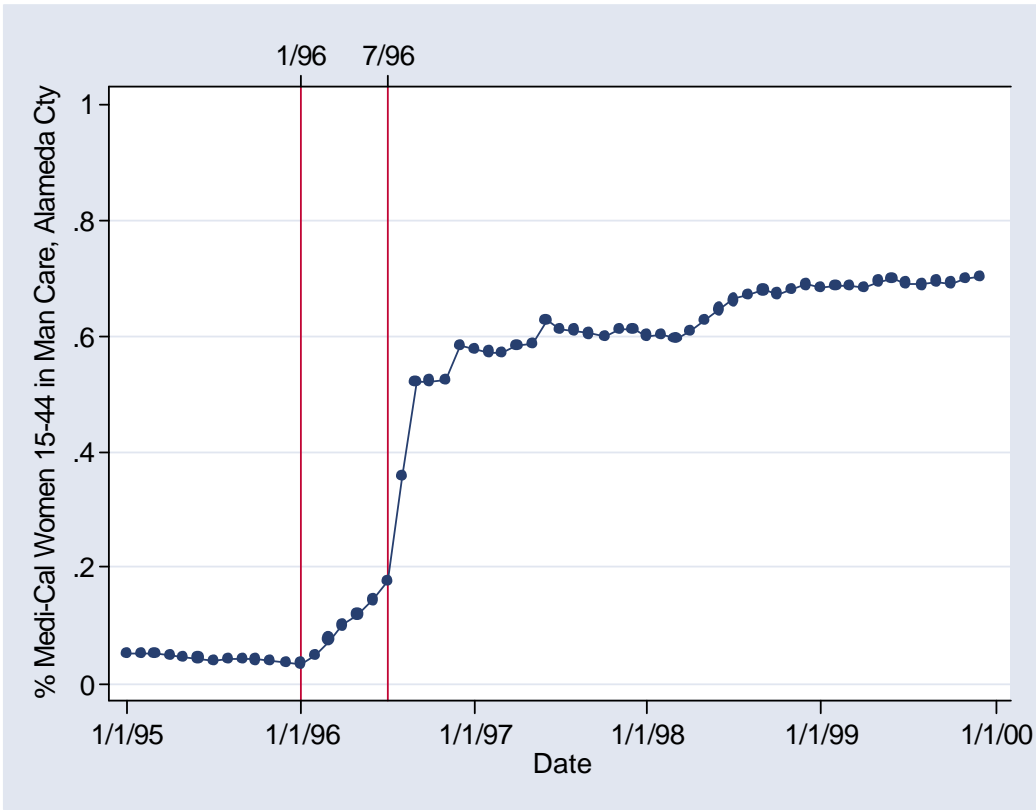


Figure 5: Share of Medi-Cal Covered Women 15-44 in Medi-Cal Managed Care, Orange County (COHS)

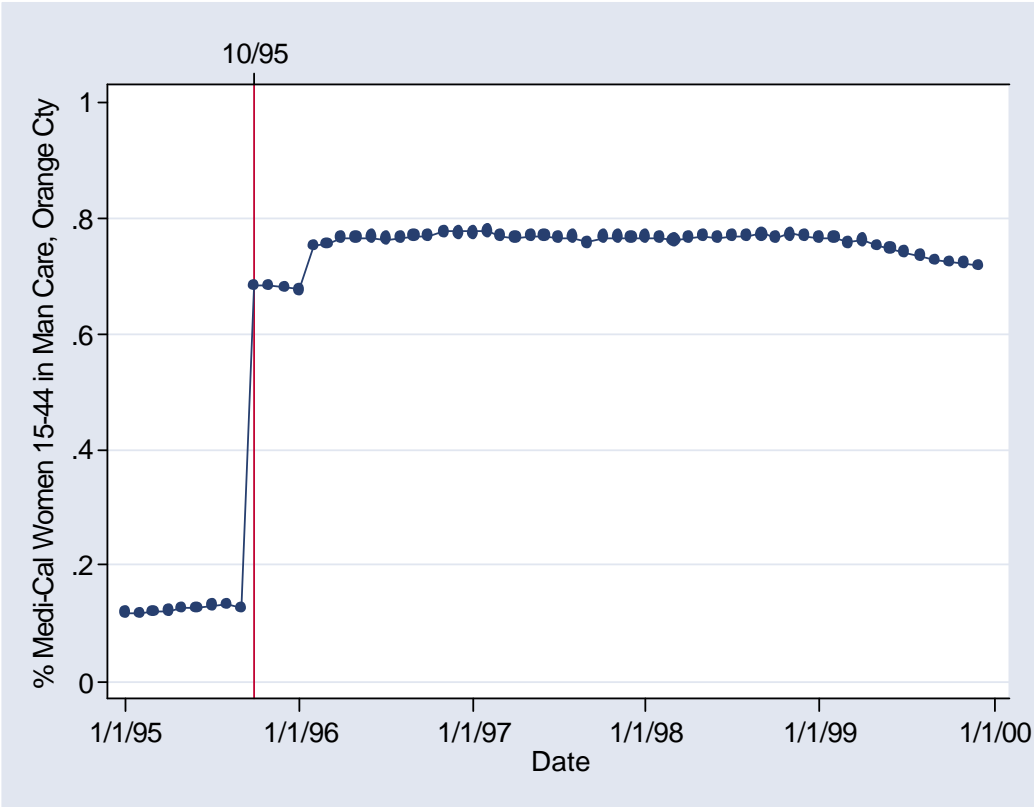


Figure 6: Share of Medi-Cal Covered Women 15-44 in Medi-Cal Managed Care, Sacramento County (GMC)

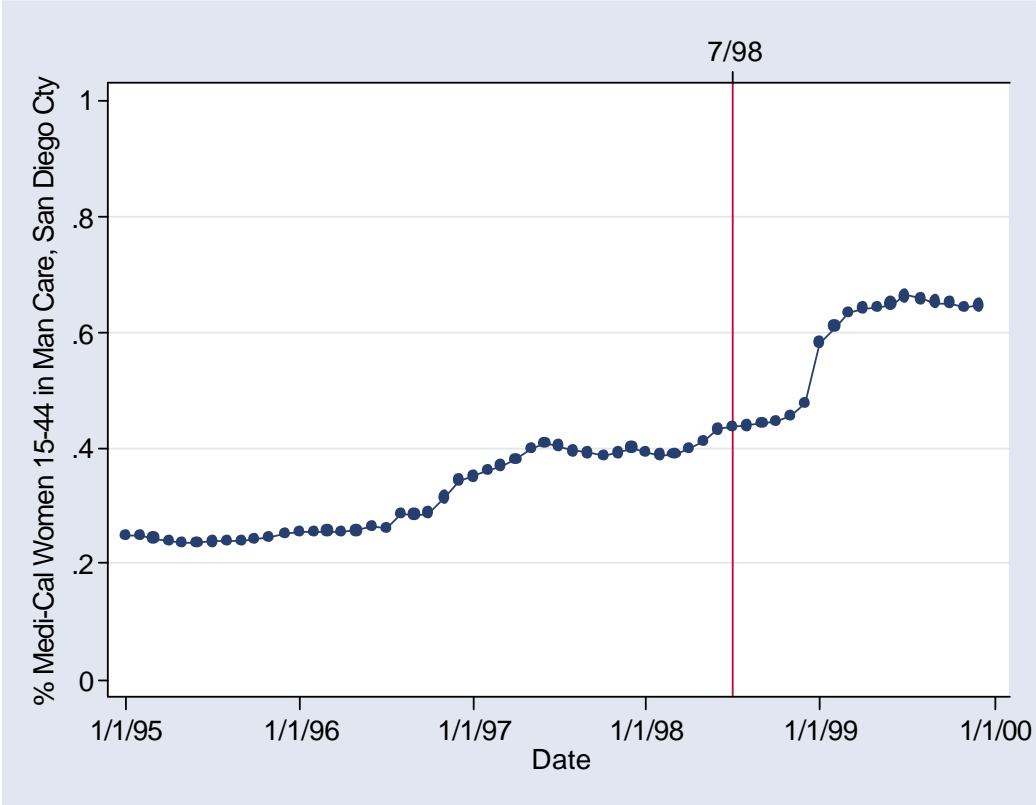


Figure 7: Trends in Medi-Cal expenditures among managed care and non-managed-care counties in California, 1994-2001

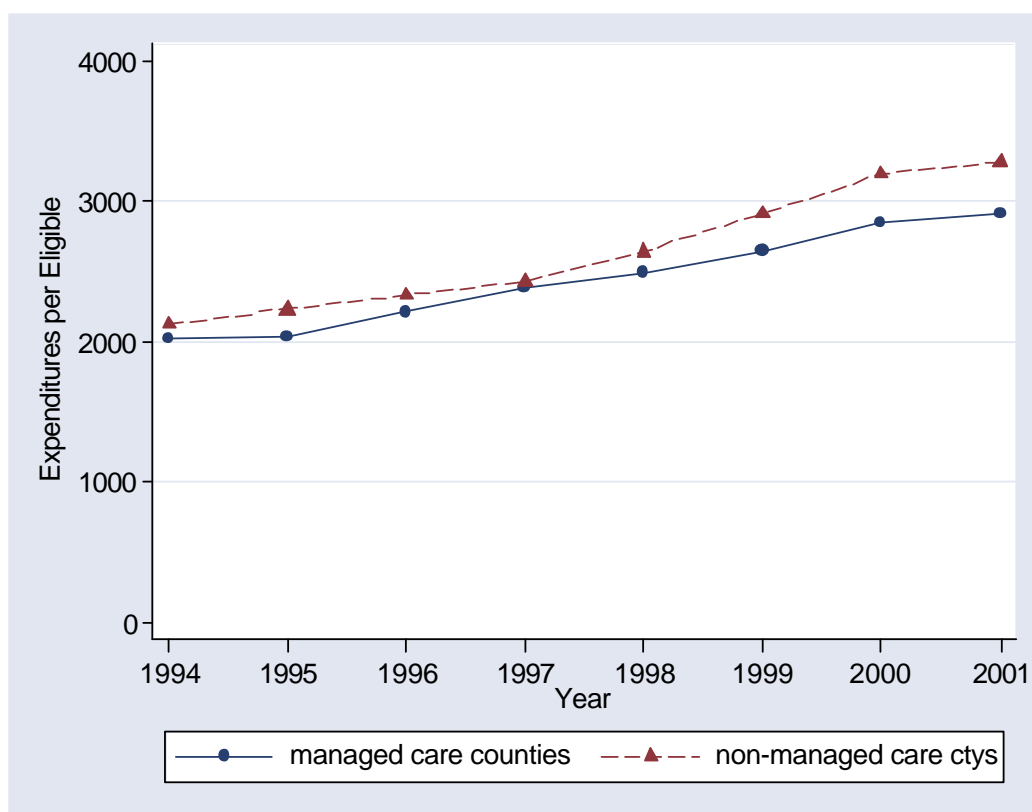


Table 1: California Counties and the Adoption of Medicaid Managed Care, counties by population

County	1998 Population	Medi-Cal Managed Care?	Implementation Began	Implementation Complete	Managed Care Type
Los Angeles	9623420	Yes	April-97	July-97	2 plan
San Diego	2823630	Yes	July-98	July-98	GMC
Orange	2744995	Yes	October-95	October-95	COHS
Santa Clara	1700976	Yes	October-96	February-97	2 plan
San Bernardino	1652363	Yes	September-96	March-98	2 plan
Riverside	1470398	Yes	September-96	March-98	2 plan
Alameda	1424779	Yes	January-96	July-96	2 plan
Sacramento*	1166303	Yes	April-94	April-94	GMC
Contra Costa	911540	Yes	February-97	March-97	2 plan
Fresno	789319	Yes	November-96	January-97	2 plan
San Francisco	784624	Yes	July-96	January-97	2 plan
Ventura	735963				
San Mateo	723524	Yes	December-87	December-87	COHS
Kern	648157	Yes	July-96	September-96	2 plan
San Joaquin	554263	Yes	February-96	January-97	2 plan
Sonoma	441349	Yes	March-97	March-97	FFS/MC
Stanislaus	434835	Yes	February-97	October-97	2 plan
Santa Barbara	404526	Yes	September-83	September-83	COHS
Monterey	387989	Yes	October-99	October-99	COHS
Solano	384847	Yes	May-94	May-94	COHS
Tulare	364335	Yes	February-99	March-99	2 plan
Santa Cruz	251475	Yes	January-96	January-96	COHS
Marin	245443				
San Luis Obispo	241169				
Placer	224464	Yes	October-97	October-97	FFS/MC
Merced	206254				
Butte	201303				
Shasta	166807				
Yolo	157717	Yes	March-01	March-01	COHS
El Dorado	151737				
Imperial	146409				
Humbolt	126862				
Napa	123118	Yes	March-98	March-98	COHS
Kings	119847				
Madera	117358				
23 counties w/ pop < 100,000					

*Sacramento's plan was fully functional in April, 1994, but has had various changes over time and only reached its current status in June, 1998.

Table 2: Regression results for total Medi-Cal spending

	Total Expend (\$b) (1)	Expend/ Eligible (2)	log Tot Expend (\$b) (3)	log Expend/ Eligible (4)
Managed Care	0.053 (0.042)	188.860 * (64.240)	0.066 * (0.021)	0.065 * (0.020)
County dummies	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes
N	176	176	176	176
R2	0.978	0.919	0.996	0.939

Note: Robust standard errors in parentheses. * denotes $p < 0.05$.

Table 3: Regression Results for Prenatal Care Use

	Num PNC visits (1)	Num PNC Visits (2)	Start 3rd Trimester (3)	Start 3rd Trimester (4)	PNC Adequate (5)	PNC Adequate (6)
% Women 15-44 in MMC	-0.437 (0.297)	-0.425 (0.297)	0.012 (0.002)	0.011 (0.002)	-0.033 (0.007)	-0.031 (0.007)
Black	---	0.542 (0.133)	---	-0.006 (0.001)	---	0.011 (0.002)
Mom's Age <20	---	0.132 (0.060)	---	0.006 (0.001)	---	-0.007 (0.001)
Mom's Age >30	---	-0.007 (0.045)	---	0.001 (0.001)	---	-0.015 (0.001)
Mom's educ <=8 yrs	---	-0.490 (0.115)	---	0.014 (0.001)	---	-0.083 (0.002)
Mom's educ 9-11 yrs	---	-0.355 (0.077)	---	0.010 (0.001)	---	-0.052 (0.002)
County Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Month Dummies	Yes	Yes	Yes	Yes	Yes	Yes
N	979,839	979,839	979,839	979,839	979,839	979,839
R2	0.018	0.018	0.007	0.008	0.014	0.020
DV Mean	14.501	14.501	0.045	0.045	0.685	0.685

Note: Robust standard errors in parentheses.

Table 4: Regression Results for Birthweight

	BW in grams (1)	BW in grams (2)	BW <2500g (3)	BW <2500g (4)
% Women 15-44 in MMC	5.686 (4.877)	6.135 (4.875)	-0.004 (0.002)	-0.003 (0.002)
PNC start 3rd trimester	---	-15.514 (2.530)	---	-0.005 (0.001)
Number PNC visits	---	0.640 (0.034)	---	-0.00019 (0.00002)
Demographics	No	Yes	No	Yes
County Dummies	Yes	Yes	Yes	Yes
Month Dummies	Yes	Yes	Yes	Yes
N	979,839	979,839	979,839	979,839
R2	0.083	0.083	0.078	0.084
DV Mean	3327	3327	0.062	0.062

Note: Robust standard errors in parentheses. Demographics includes multiple birth, mom's age, race, and education.

Table 5: Regression Results for Utilization

	Mom's LOS (days) (1)	Birth in Public Hospital (2)	Fetal Monitoring (3)	Induction (4)	Primary Cesarean (5)	VBAC (6)
% Women 15-44 in MMC	-0.069 (0.027)	-0.048 (0.003)	-0.016 (0.004)	0.014 (0.003)	-0.0004 (0.0030)	0.058 (0.011)
Demographics	Yes	Yes	Yes	Yes	Yes	Yes
Birthweight	Yes	Yes	Yes	Yes	Yes	Yes
Prenatal Care	Yes	Yes	Yes	Yes	Yes	Yes
County Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Month Dummies	Yes	Yes	Yes	Yes	Yes	Yes
N	979,839	979,839	979,839	979,839	877,058	102,781
R2	0.029	0.201	0.118	0.018	0.057	0.043
DV Mean	1.985	0.183	0.607	0.084	0.133	0.183

Note: Robust standard errors in parentheses. Demographics includes multiple birth, moms race, age, and education. Birthweight includes dummies for 500-749, 750-999, 1000-1249, 1250-1499, 1500-1999, 2000-2499, 2500-3999, and ≥ 4000 g. Prenatal care includes number of visits and a dummy for starting prenatal care in the 3rd trimester.

Table 6: NICU access, VLBW and LBW

	500-1499g				1500-2499g			
	Birth Level 2+/3 (1)	Birth Level 3 (2)	Highest Level 2+/3 (3)	Highest Level 3 (4)	Birth Level 2+/3 (5)	Birth level3 (6)	Highest Level 2+/3 (7)	Highest Level 3 (8)
% women 15-44 in MC	0.028 (0.036)	0.056 (0.032)	-0.025 (0.029)	-0.055 (0.040)	0.030 (0.012)	-0.004 (0.018)	-0.016 (0.017)	0.022 (0.014)
Area level 2+ hosps/birth	0.830 (0.125)	0.057 (0.087)	0.381 (0.109)	-0.406 (0.119)	-0.019 (0.030)	1.042 (0.060)	0.943 (0.059)	-0.128 (0.035)
Area level 3 hosps/birth	0.950 (0.135)	1.145 (0.141)	0.744 (0.116)	0.964 (0.146)	0.729 (0.056)	0.594 (0.063)	0.610 (0.062)	0.732 (0.058)
Demographics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birthweight	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Prenatal Care	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
County Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Month Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	10335	10335	10335	10335	53205	53205	53205	53,205
R2	0.132	0.205	0.072	0.146	0.146	0.125	0.118	0.122
DV Mean	0.772	0.289	0.886				0.651	0.208

Note: Robust standard errors in parentheses. Demographics includes multiple birth, moms race, age, and education. Birthweight includes dummies for 500-749, 750-999, 1000-1249, 1250-1499, 1500-1999, 2000-2499, 2500-3999, and ≥ 4000 g. Prenatal care includes number of visits and a dummy for starting prenatal care in the 3rd trimester.

Table 7: Outcome Measures

	28-Day Mortality				BPD		IVH	
	500-1500g (1)	500-1500g (2)	1500-2500g (3)	1500-2500g (4)	500-1500g (5)	500-1500g (6)	500-1500g	500-1500g
% women 15-44 in MC	-0.028 (0.029)	-0.027 (0.029)	0.005 (0.005)	0.005 (0.005)	-0.073 (0.034)	-0.072 (0.034)	-0.065 (0.030)	-0.066 (0.030)
Demographics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birthweight	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Prenatal Care	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bth hosp NICU level	No	Yes	No	Yes	No	Yes	No	Yes
County Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Month Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	10335	10335	53205	53205	10335	10335	10335	10335
R2	0.204	0.204	0.009	0.010	0.119	0.119	0.049	0.051
DV Mean	0.168	0.168	0.014	0.014	0.244	0.244	0.151	0.151

Note: Robust standard errors in parentheses. Demographics includes multiple birth, moms race, age, and education. Birthweight includes dummies for 500-749, 750-999, 1000-1249, 1250-1499, 1500-1999, 2000-2499, 2500-3999, and ≥ 4000 g. Prenatal care includes number of visits and a dummy for starting prenatal care in the 3rd trimester. Birth hospital NICU level includes dummies for birth in a level 2, 2+, or 3 facility.